FIG.1 PRIOR ART

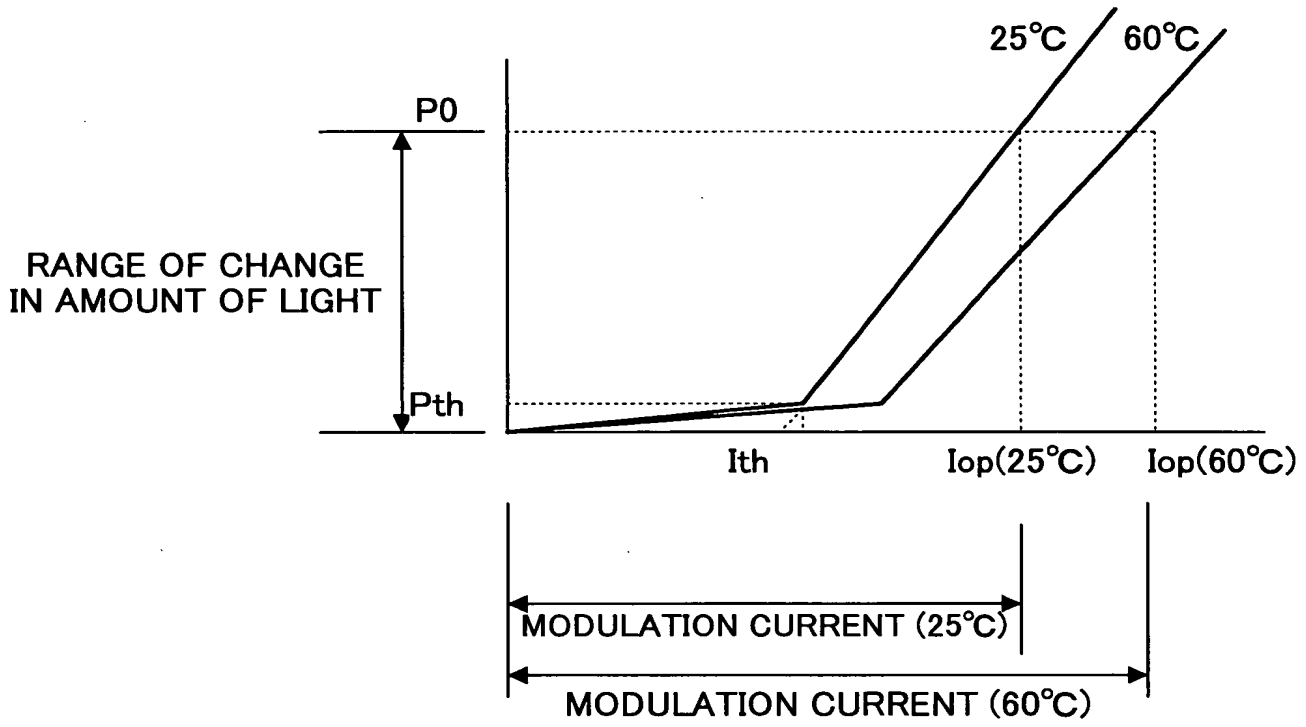


FIG.2 PRIOR ART

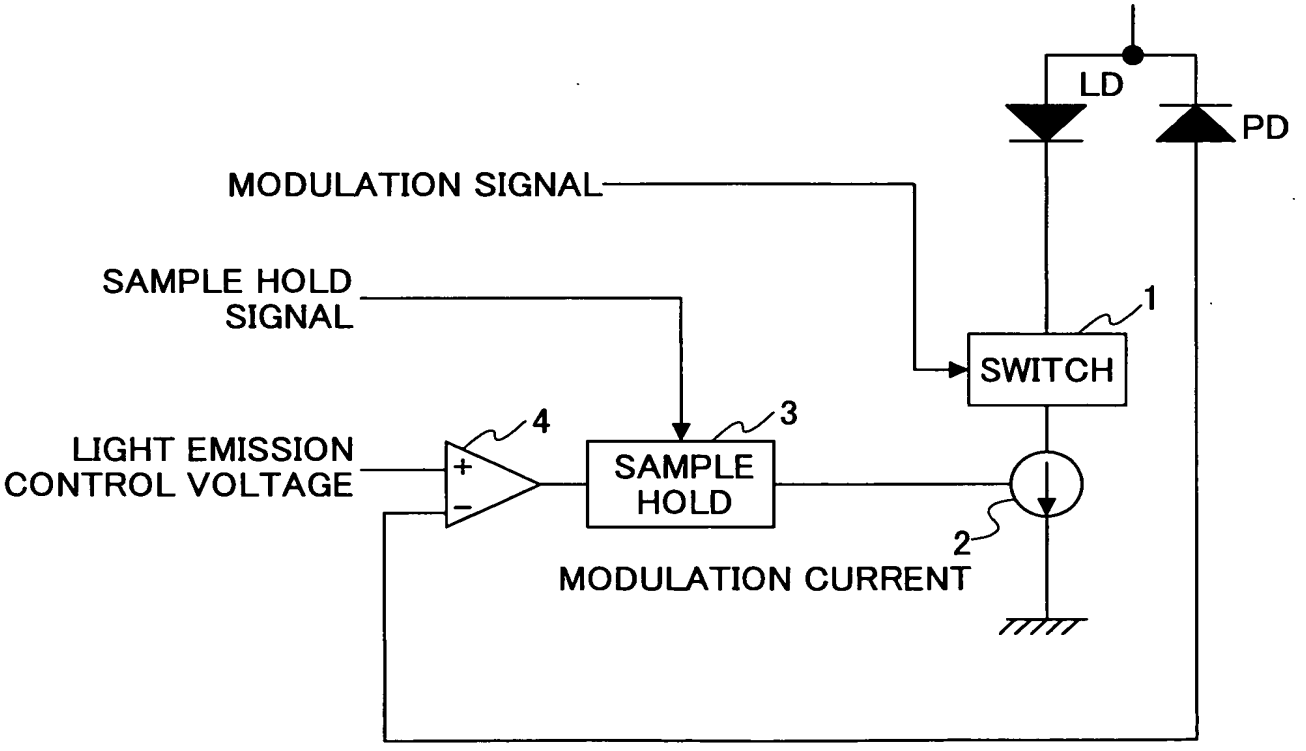


FIG.3 PRIOR ART

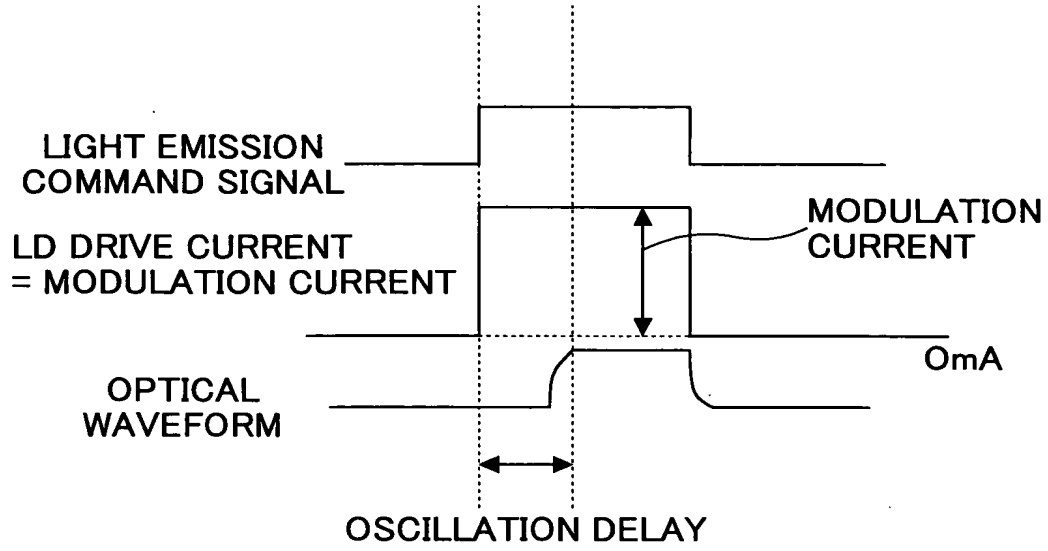


FIG.4 PRIOR ART

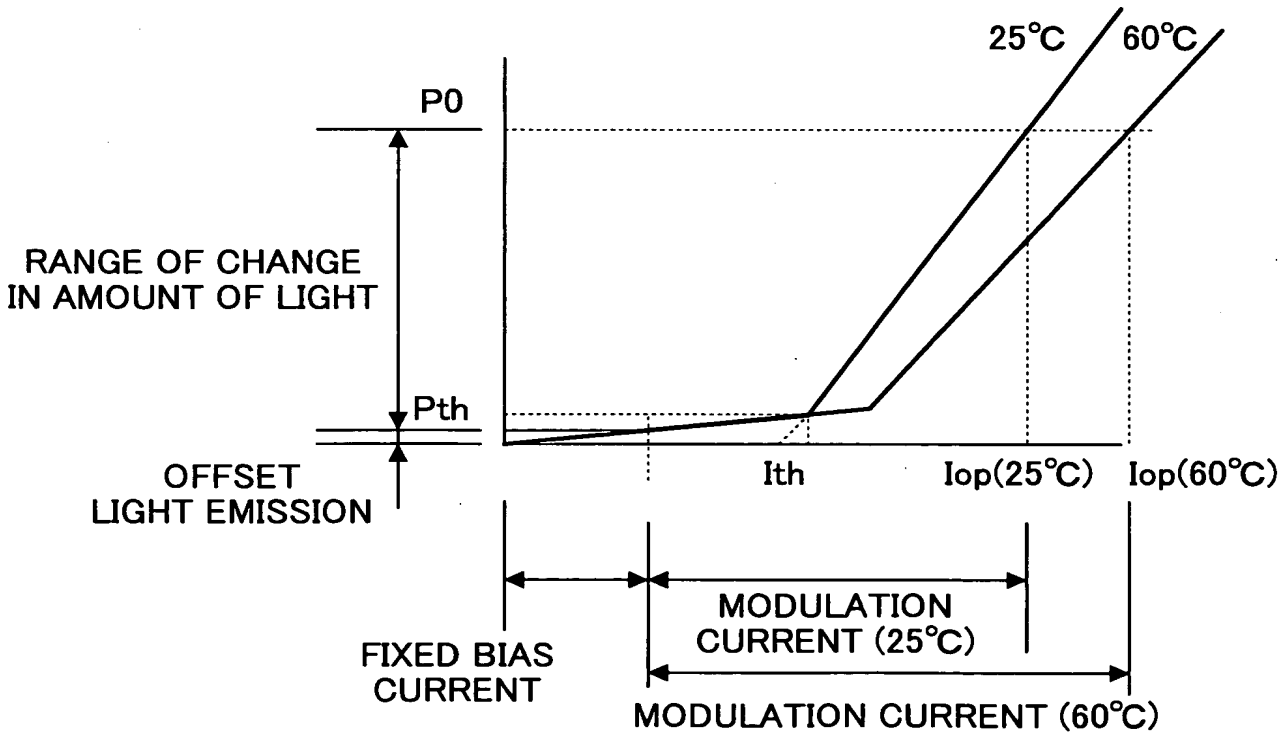


FIG.5 PRIOR ART

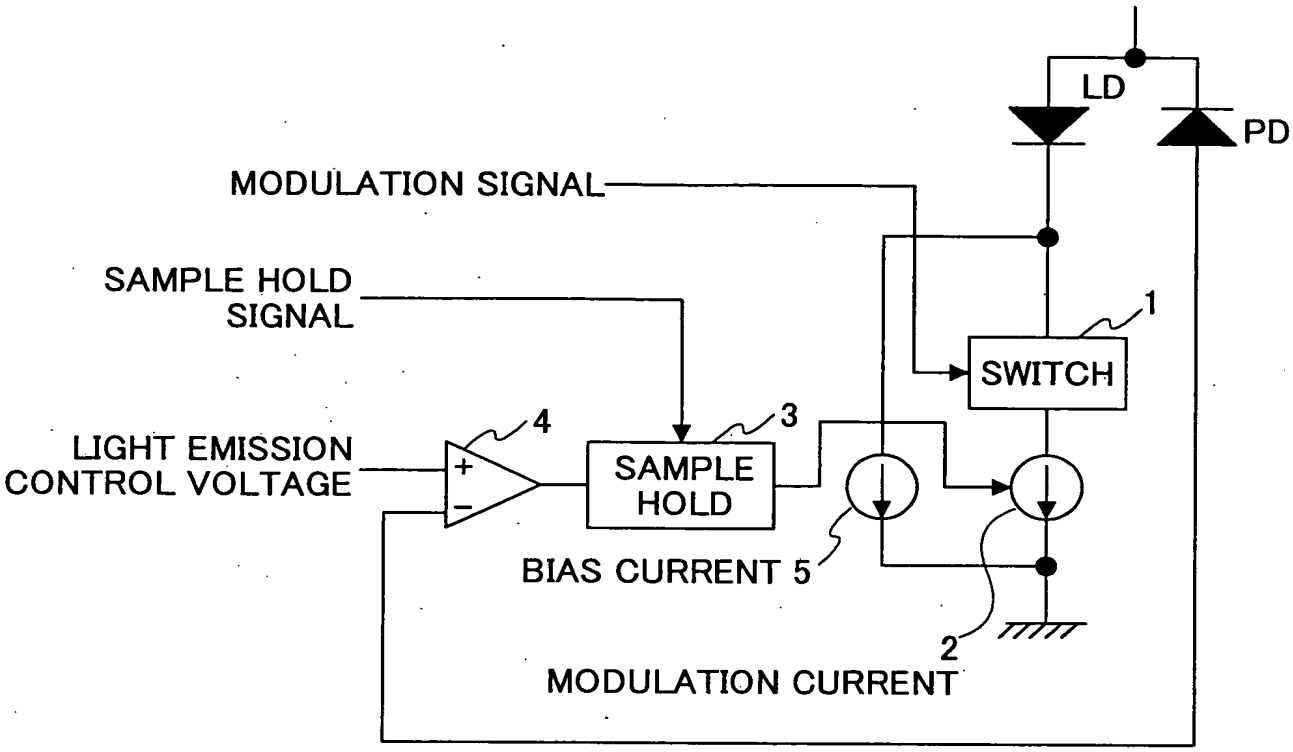


FIG.6 PRIOR ART

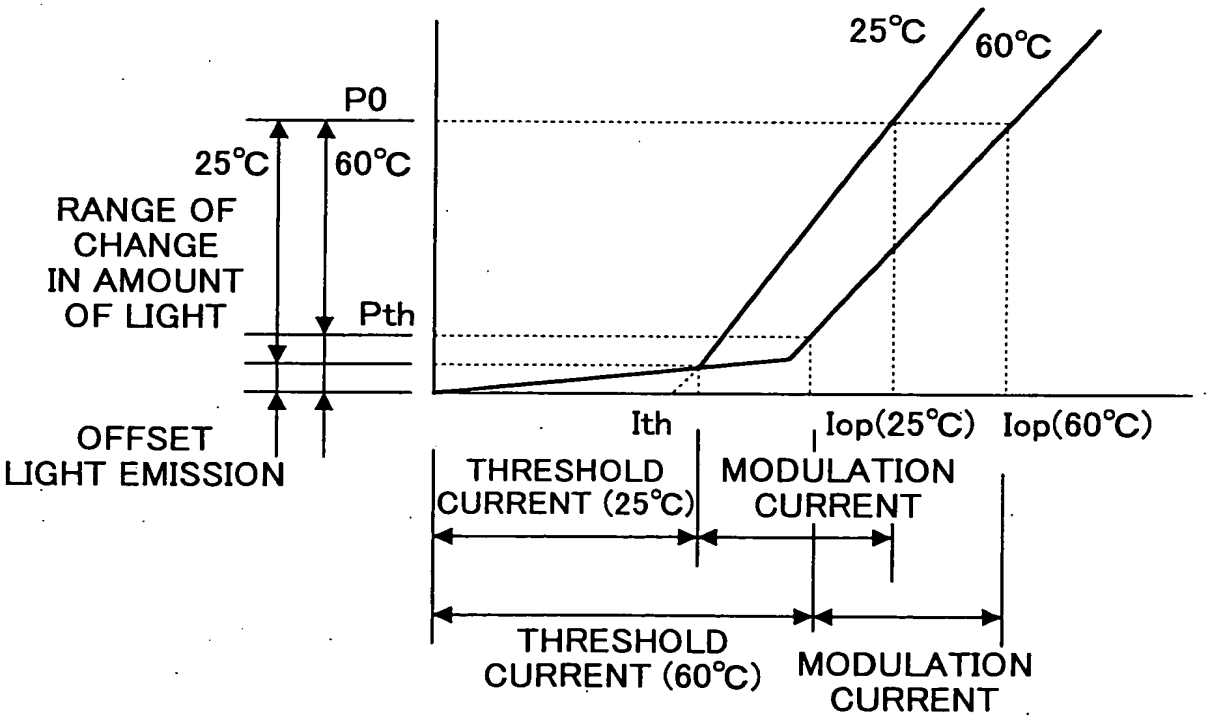


FIG.7 PRIOR ART

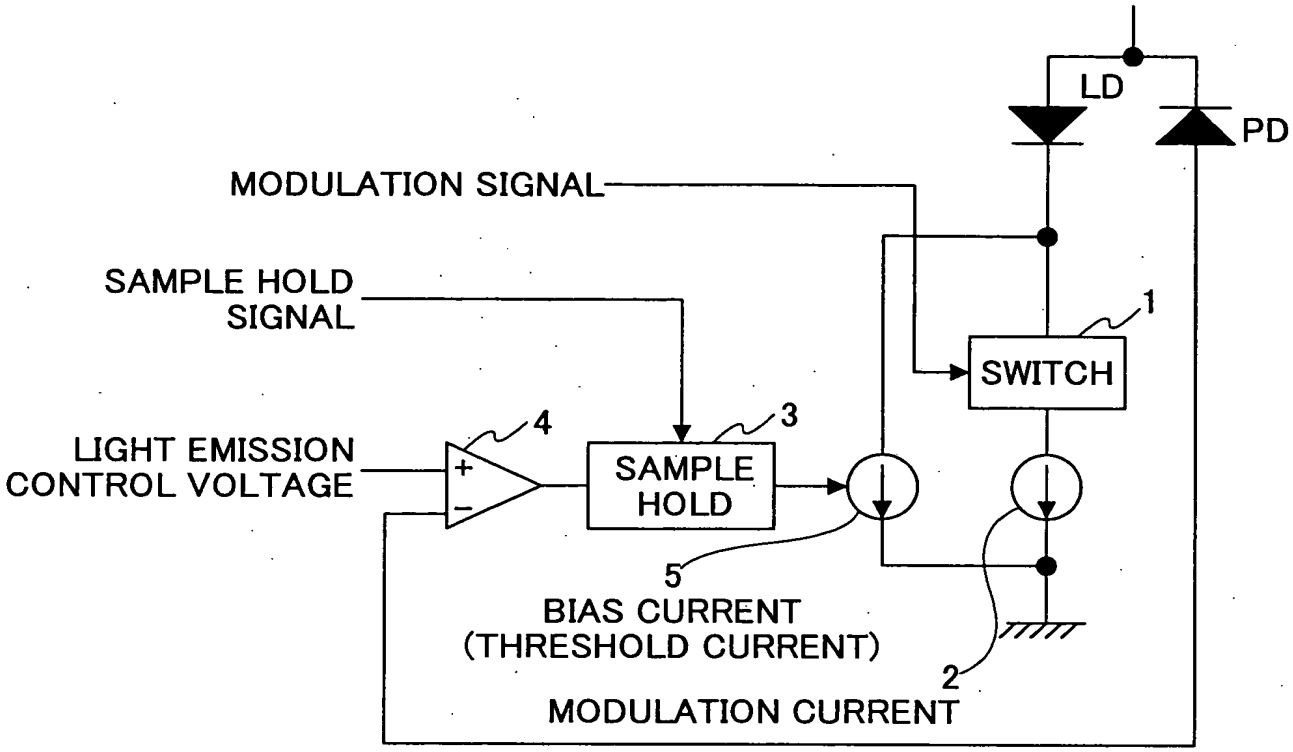


FIG.8

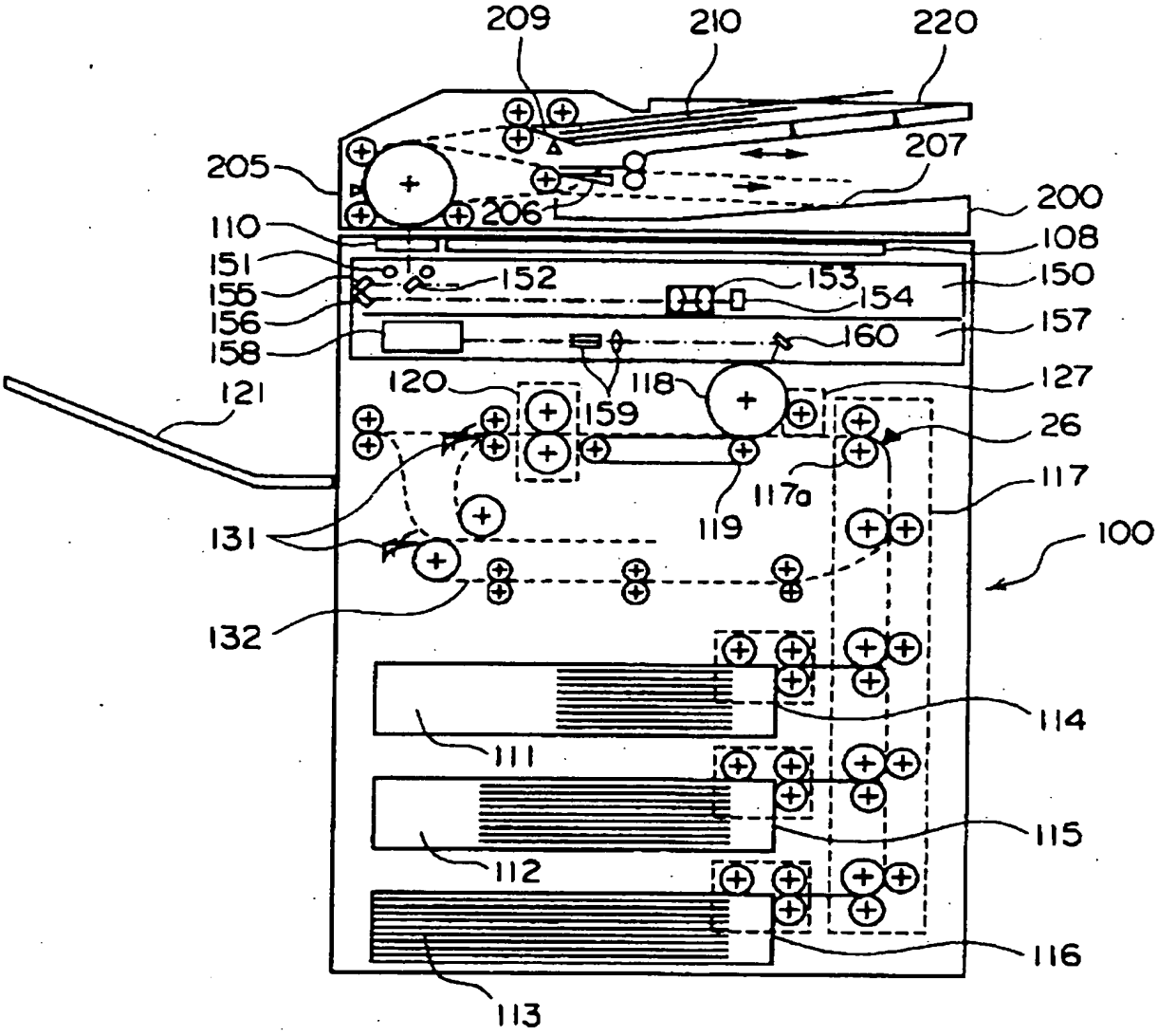

209
210
220
205
207
206
200
110
108
151
152
153
150
155
154
156
157
158
160
121
120
118
127
159
26
117a
117
131
119
100
132
114
111
115
112
116
113

FIG.9

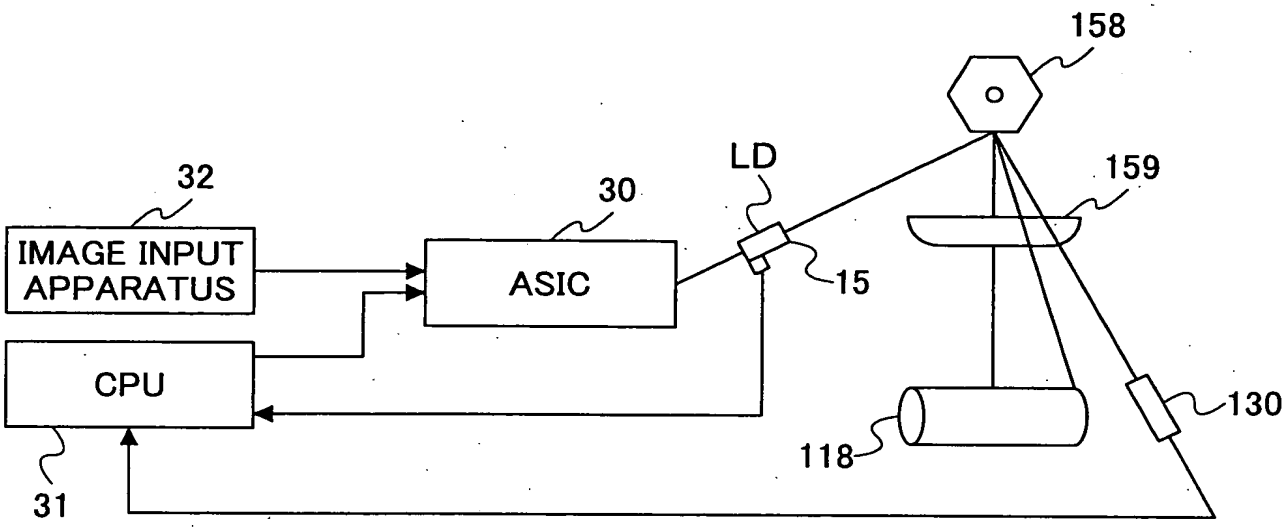


FIG.10

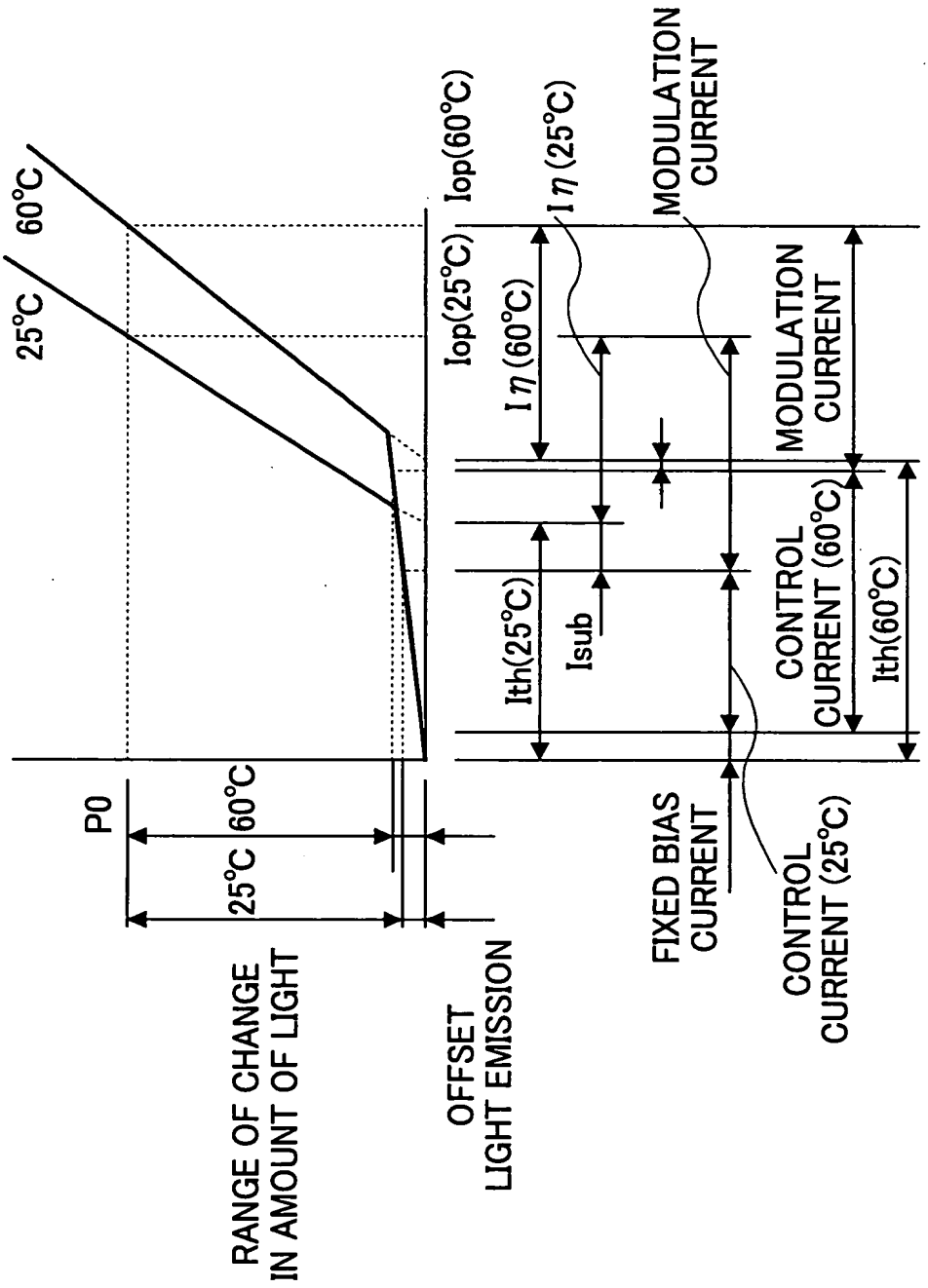

25°C
60°C
P0
25°C
60°C
RANGE OF CHANGE IN AMOUNT OF LIGHT
OFFSET LIGHT EMISSION
Iop(25°C)
Iop(60°C)
Iη(60°C)
Iη(25°C)
MODULATION CURRENT
MODULATION CURRENT
Ith(25°C)
Isub
CONTROL CURRENT (60°C)
Ith(60°C)
FIXED BIAS CURRENT
CONTROL CURRENT (25°C)

FIG.11

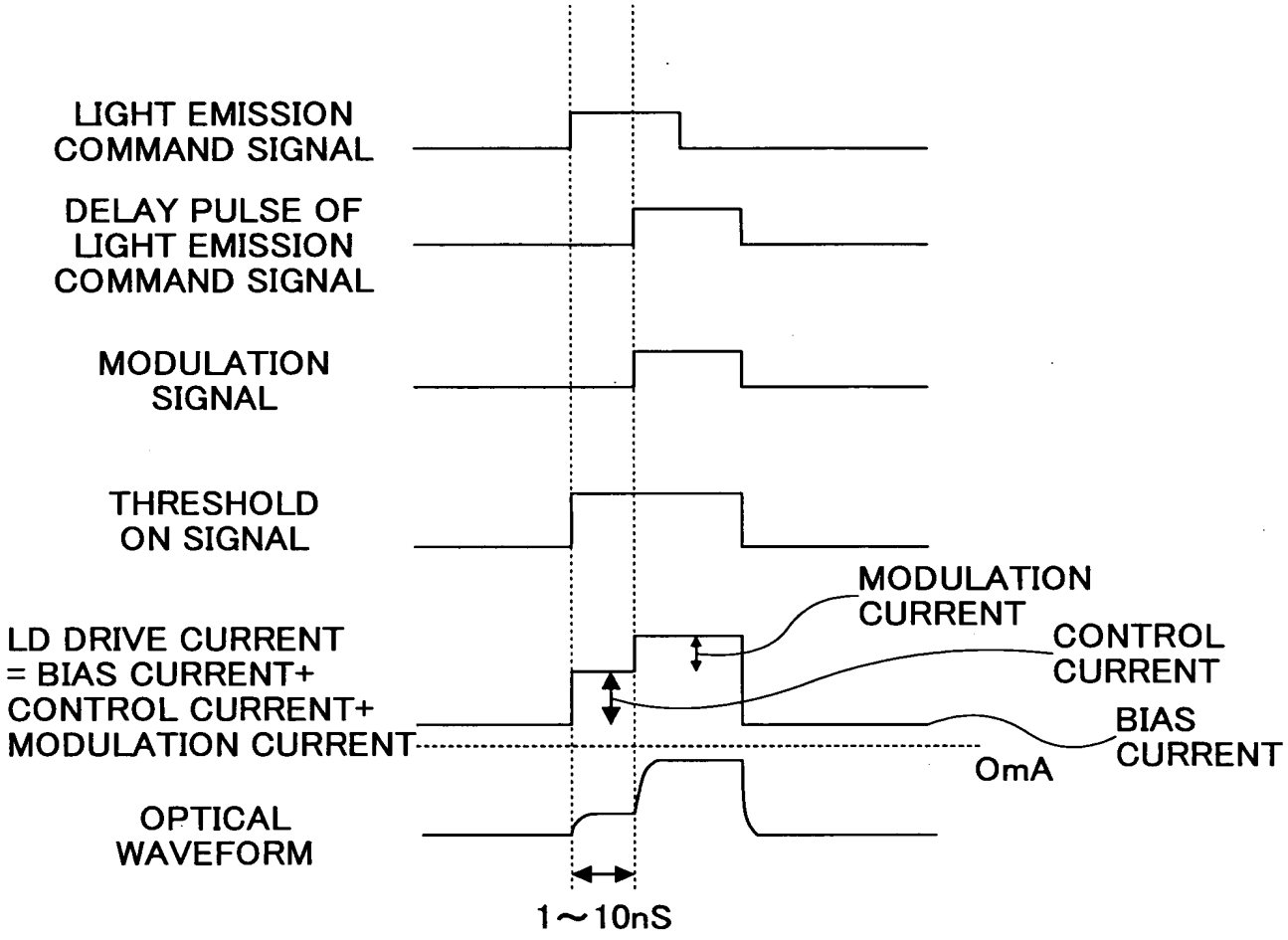

LIGHT EMISSION COMMAND SIGNAL
DELAY PULSE OF LIGHT EMISSION COMMAND SIGNAL
MODULATION SIGNAL
THRESHOLD ON SIGNAL
LD DRIVE CURRENT = BIAS CURRENT+ CONTROL CURRENT+ MODULATION CURRENT
MODULATION CURRENT
CONTROL CURRENT
BIAS CURRENT
OmA
OPTICAL WAVEFORM
1～10nS

FIG.12

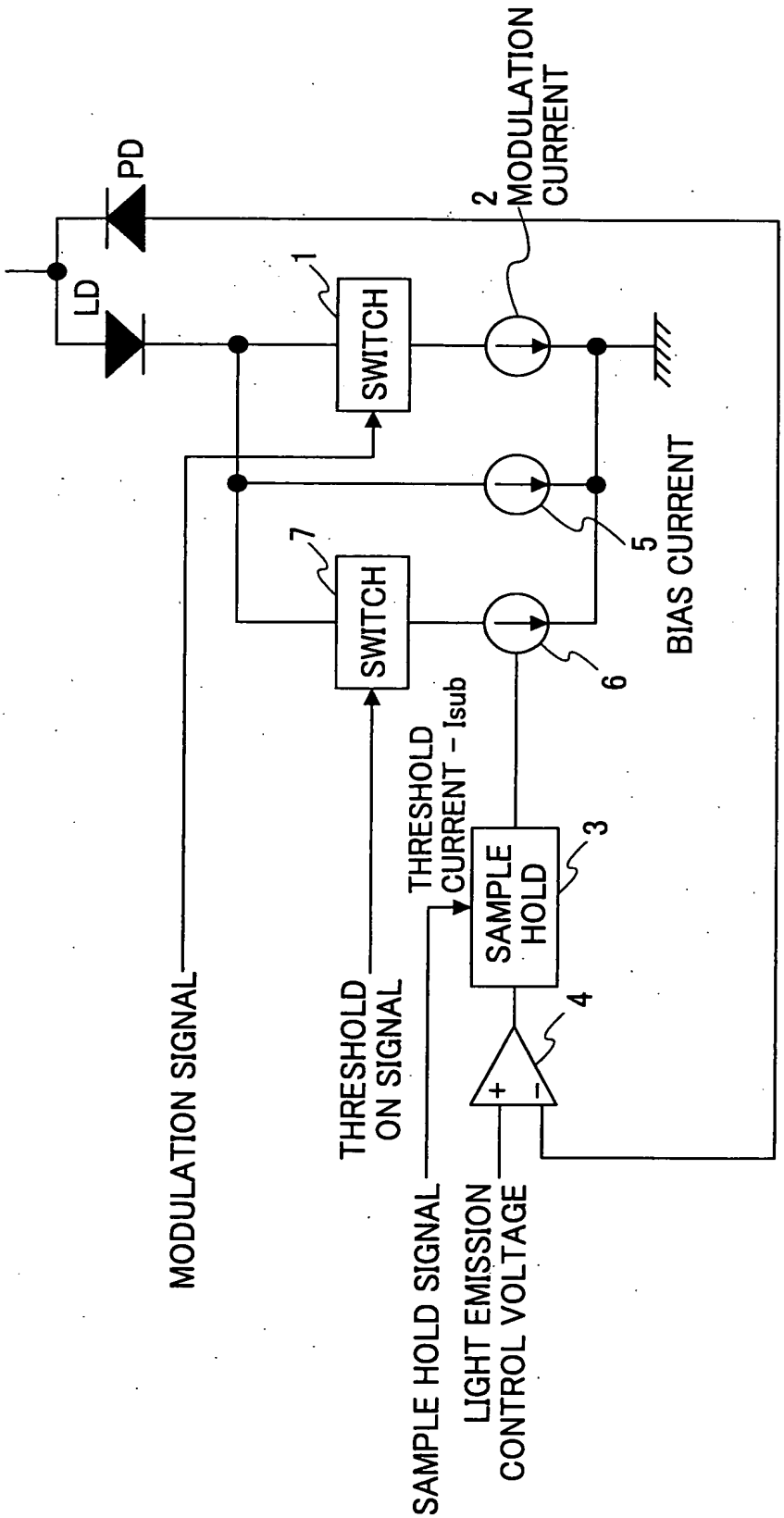

PD
LD
1
SWITCH
2
MODULATION CURRENT
5
BIAS CURRENT
7
SWITCH
6
THRESHOLD CURRENT – Isub
3
SAMPLE HOLD
4
+
–
MODULATION SIGNAL
THRESHOLD ON SIGNAL
SAMPLE HOLD SIGNAL
LIGHT EMISSION CONTROL VOLTAGE

FIG.13

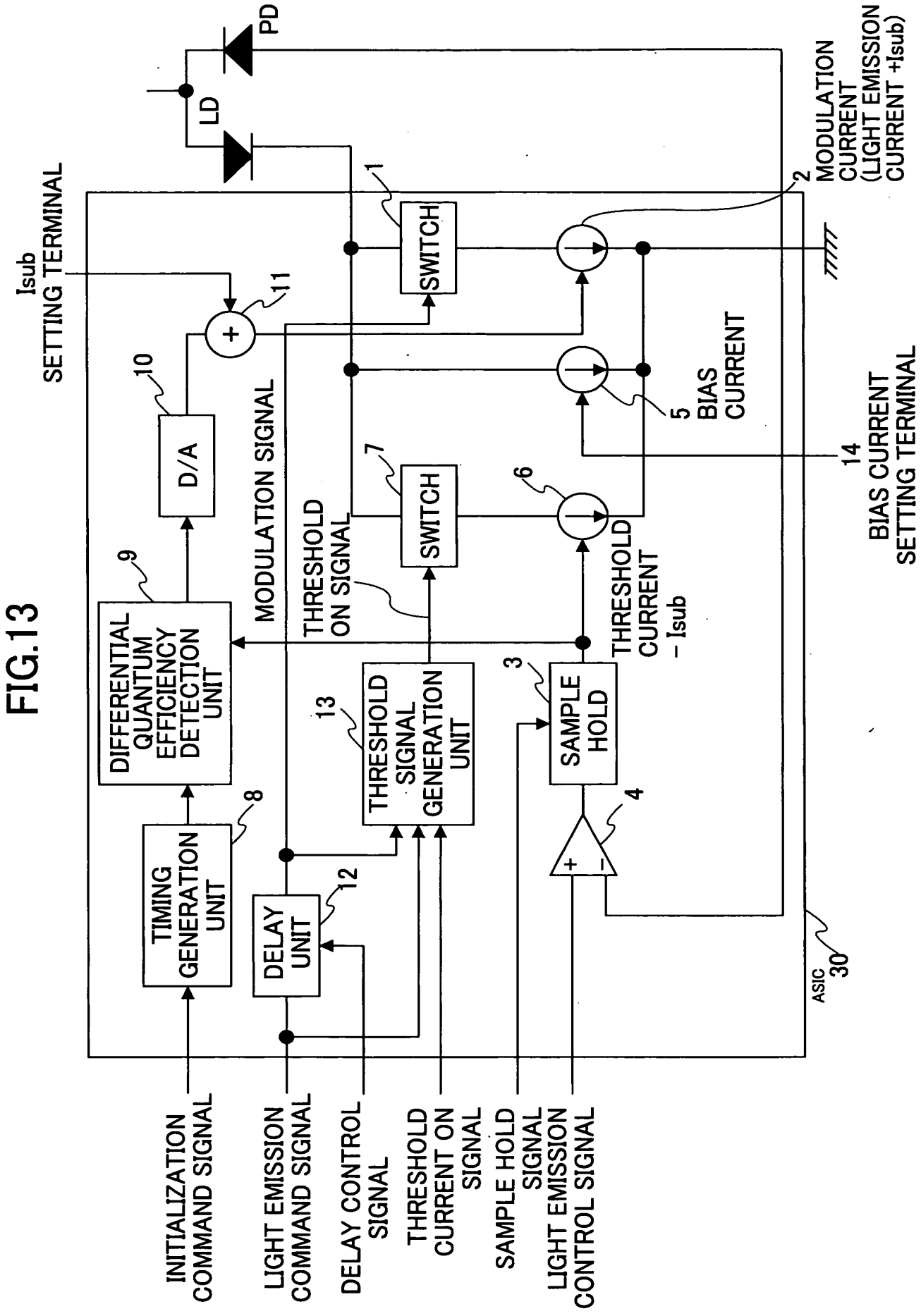

PD
LD
Isub
SETTING TERMINAL
MODULATION
CURRENT
(LIGHT EMISSION
CURRENT +Isub)
SWITCH
SWITCH
SWITCH
D/A
BIAS
CURRENT
BIAS CURRENT
SETTING TERMINAL
MODULATION SIGNAL
THRESHOLD
ON SIGNAL
THRESHOLD
CURRENT
– Isub
DIFFERENTIAL
QUANTUM
EFFICIENCY
DETECTION
UNIT
TIMING
GENERATION
UNIT
DELAY
UNIT
THRESHOLD
SIGNAL
GENERATION
UNIT
SAMPLE
HOLD
ASIC
INITIALIZATION
COMMAND SIGNAL
LIGHT EMISSION
COMMAND SIGNAL
DELAY CONTROL
SIGNAL
THRESHOLD
CURRENT ON
SIGNAL
SAMPLE HOLD
SIGNAL
LIGHT EMISSION
CONTROL SIGNAL

FIG.14

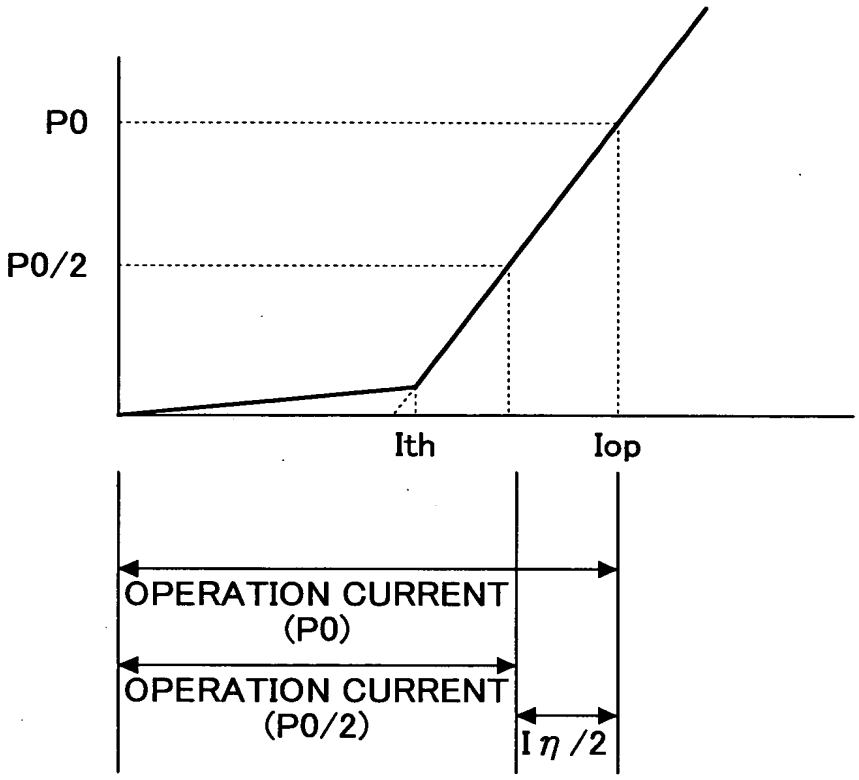

P0
P0/2
Ith
Iop
OPERATION CURRENT
(P0)
OPERATION CURRENT
(P0/2)
I η /2

FIG.15

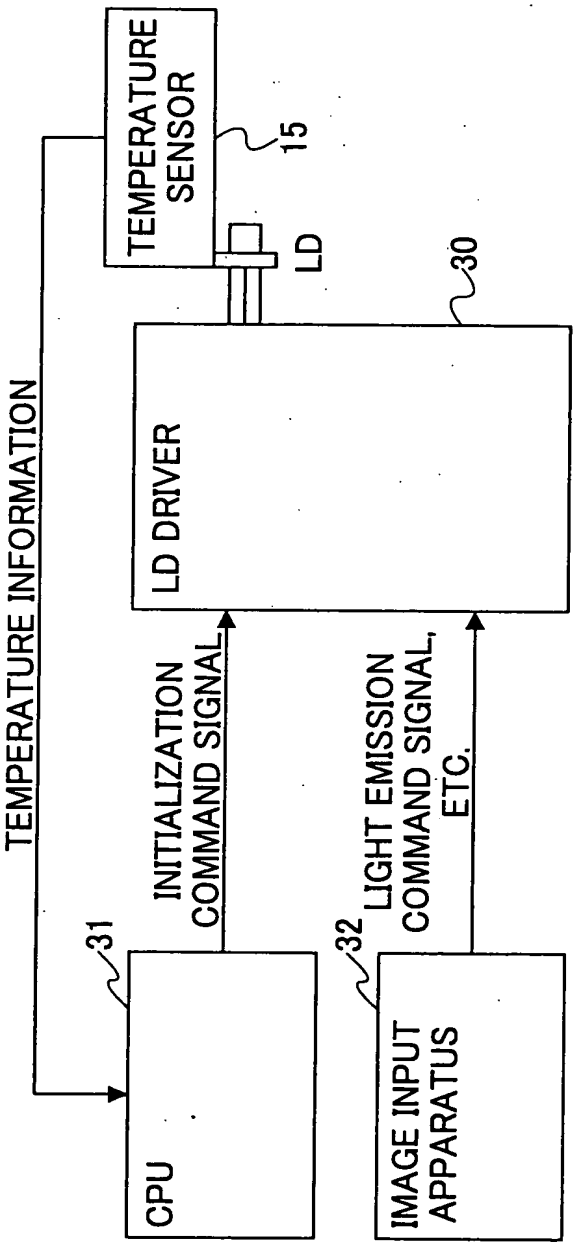

TEMPERATURE SENSOR
15
LD
30
LD DRIVER
TEMPERATURE INFORMATION
INITIALIZATION COMMAND SIGNAL
LIGHT EMISSION COMMAND SIGNAL, ETC.
31
32
CPU
IMAGE INPUT APPARATUS

FIG.16

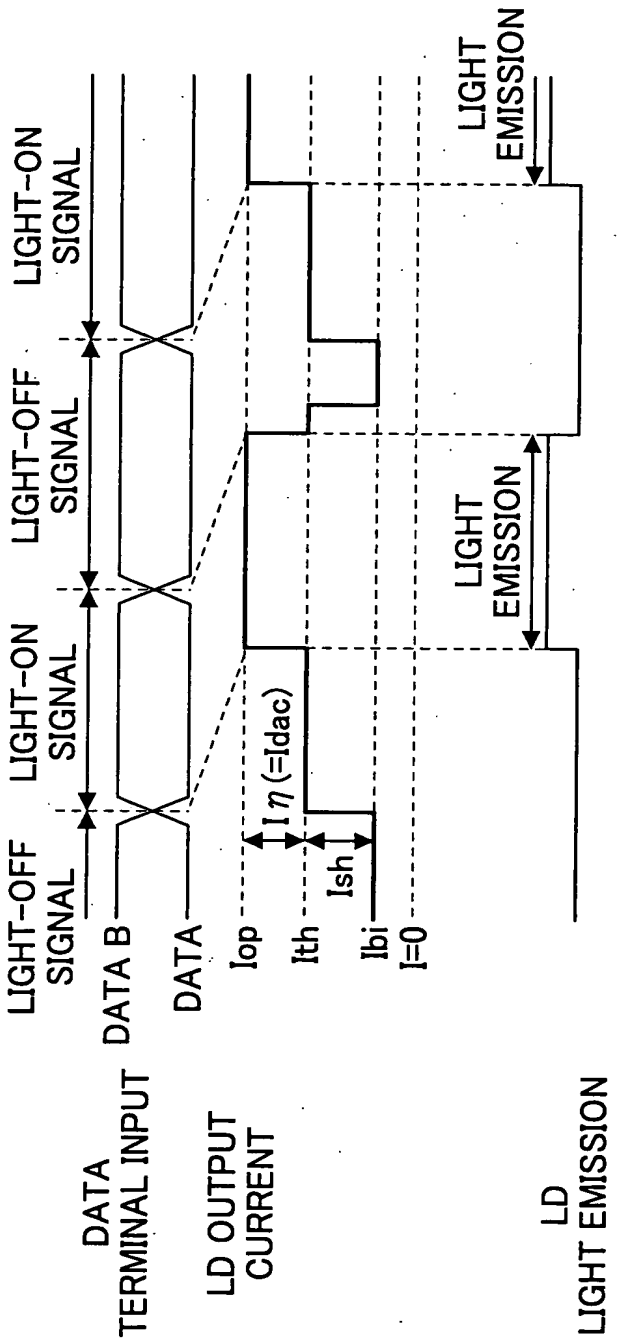

LIGHT-OFF SIGNAL
LIGHT-ON SIGNAL
LIGHT-OFF SIGNAL
LIGHT-ON SIGNAL
DATA B
DATA
Iop
Ith
Ibi
I=0
Ish
Iη (=Idac)
LIGHT EMISSION
LIGHT EMISSION
DATA TERMINAL INPUT
LD OUTPUT CURRENT
LD LIGHT EMISSION

FIG.17

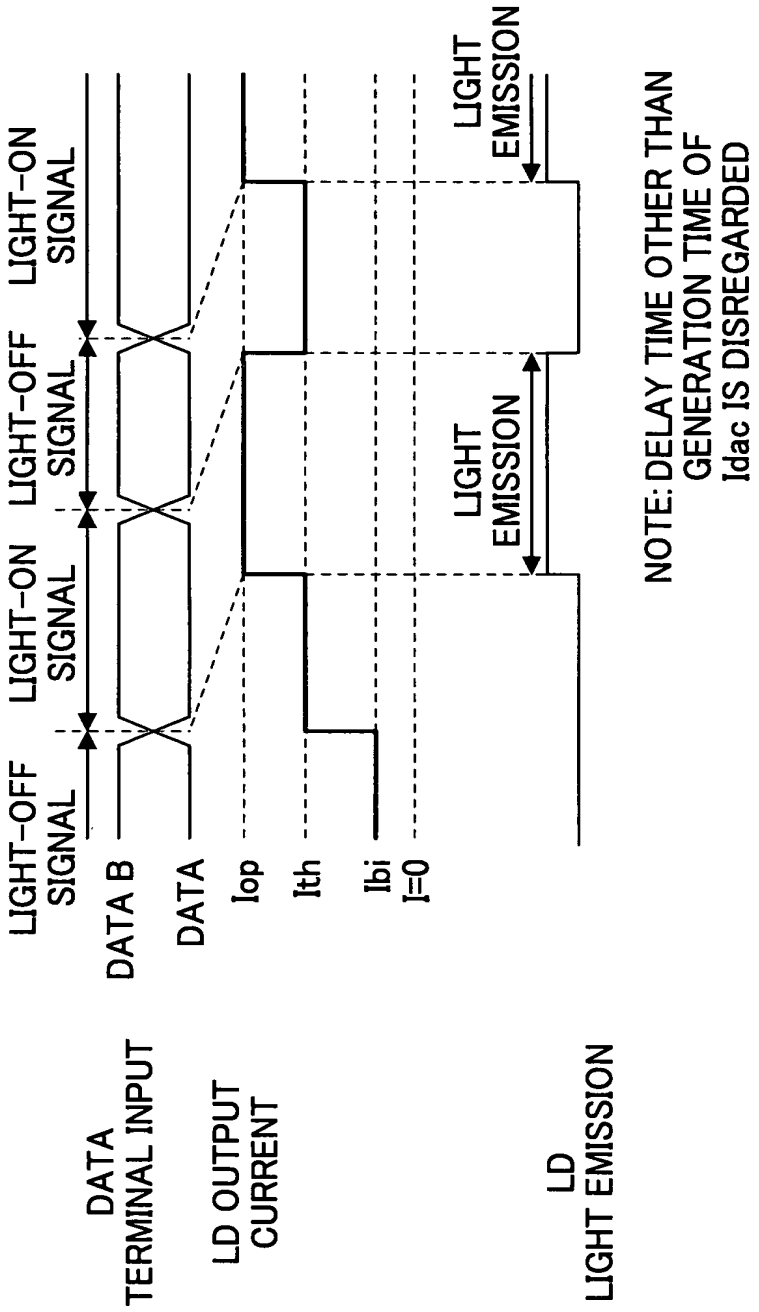

DATA TERMINAL INPUT
LD OUTPUT CURRENT
LD LIGHT EMISSION
LIGHT-OFF SIGNAL
LIGHT-ON SIGNAL
LIGHT-OFF SIGNAL
LIGHT-ON SIGNAL
DATA B
DATA
Iop
Ith
Ibi
I=0
LIGHT EMISSION
LIGHT EMISSION
NOTE: DELAY TIME OTHER THAN GENERATION TIME OF Idac IS DISREGARDED

FIG.18

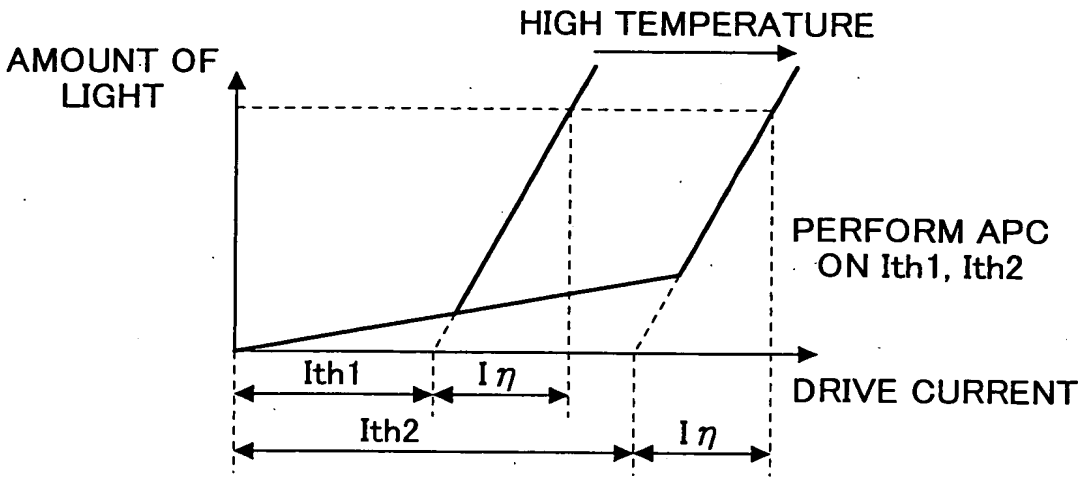

HIGH TEMPERATURE
AMOUNT OF LIGHT
PERFORM APC ON Ith1, Ith2
Ith1
Iη
DRIVE CURRENT
Ith2
Iη

FIG.19

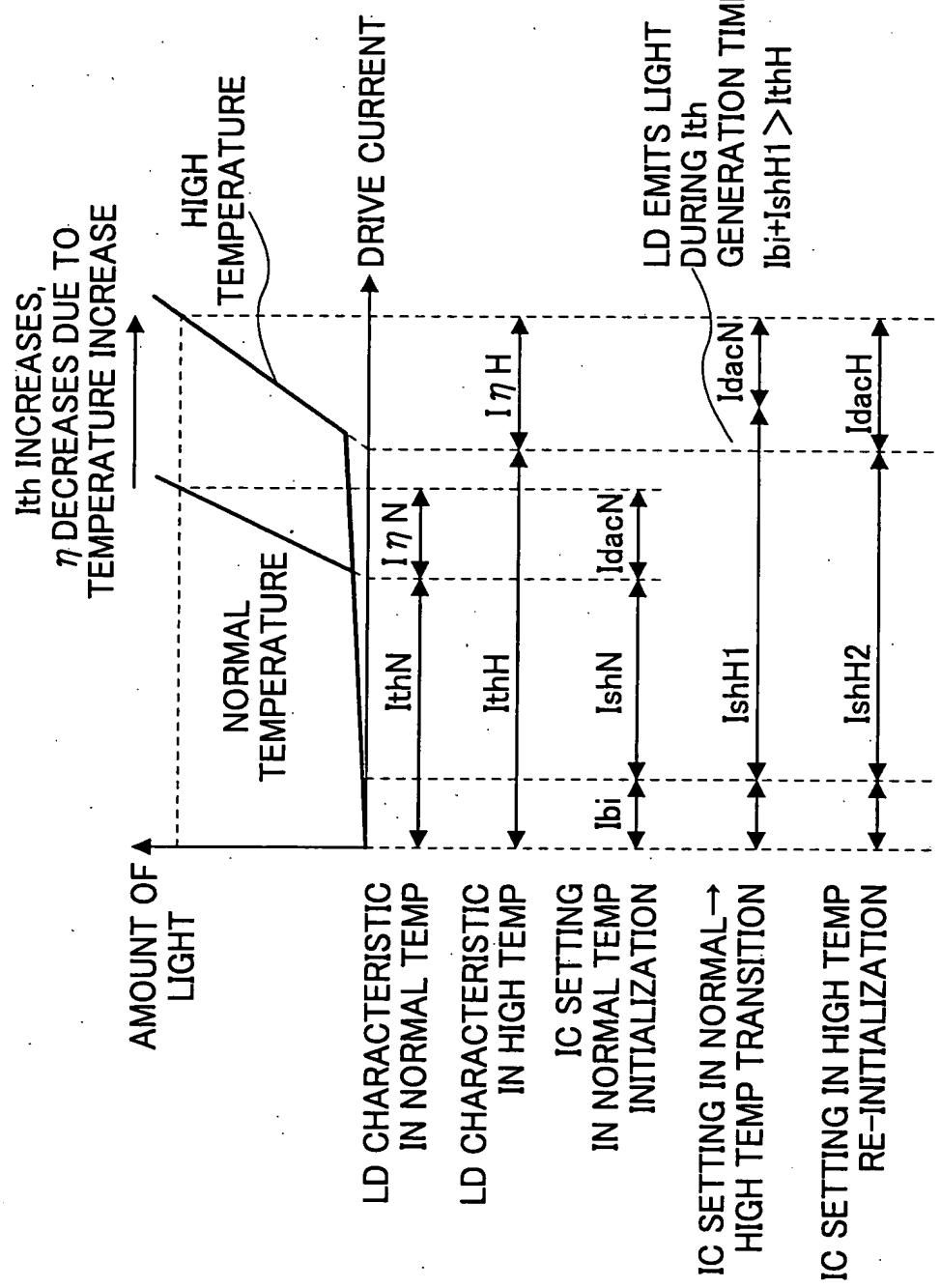

Ith INCREASES,
η DECREASES DUE TO
TEMPERATURE INCREASE
HIGH
TEMPERATURE
NORMAL
TEMPERATURE
DRIVE CURRENT
AMOUNT OF
LIGHT
IthN
IηN
IthH
IηH
Ibi
IshN
IdacN
IshH1
IdacN
IshH2
IdacH
LD EMITS LIGHT
DURING Ith
GENERATION TIME
Ibi+IshH1>IthH
LD CHARACTERISTIC
IN NORMAL TEMP
LD CHARACTERISTIC
IN HIGH TEMP
IC SETTING
IN NORMAL TEMP
INITIALIZATION
IC SETTING IN NORMAL→
HIGH TEMP TRANSITION
IC SETTING IN HIGH TEMP
RE-INITIALIZATION

FIG.20

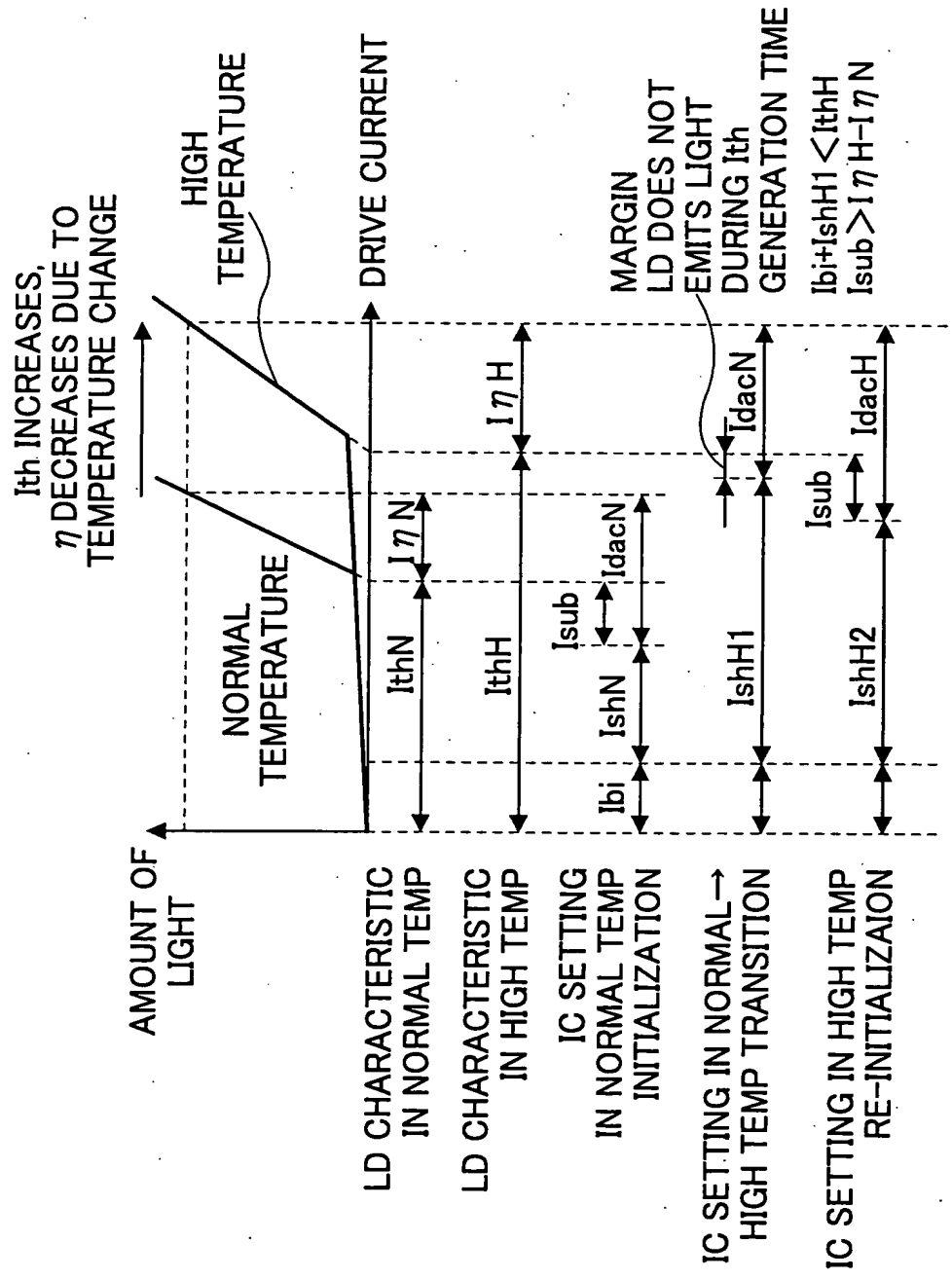

Ith INCREASES, η DECREASES DUE TO TEMPERATURE CHANGE
HIGH TEMPERATURE
NORMAL TEMPERATURE
DRIVE CURRENT
AMOUNT OF LIGHT
IthN
Iη N
IthH
Iη H
Isub
IdacN
IshN
Ibi
IshH1
IshH2
MARGIN
LD DOES NOT EMITS LIGHT DURING Ith GENERATION TIME
Ibi+IshH1 < IthH
Isub > Iη H−Iη N
LD CHARACTERISTIC IN NORMAL TEMP
LD CHARACTERISTIC IN HIGH TEMP
IC SETTING IN NORMAL TEMP INITIALIZATION
IC SETTING IN NORMAL→ HIGH TEMP TRANSITION
IC SETTING IN HIGH TEMP RE-INITIALIZAION

FIG.21

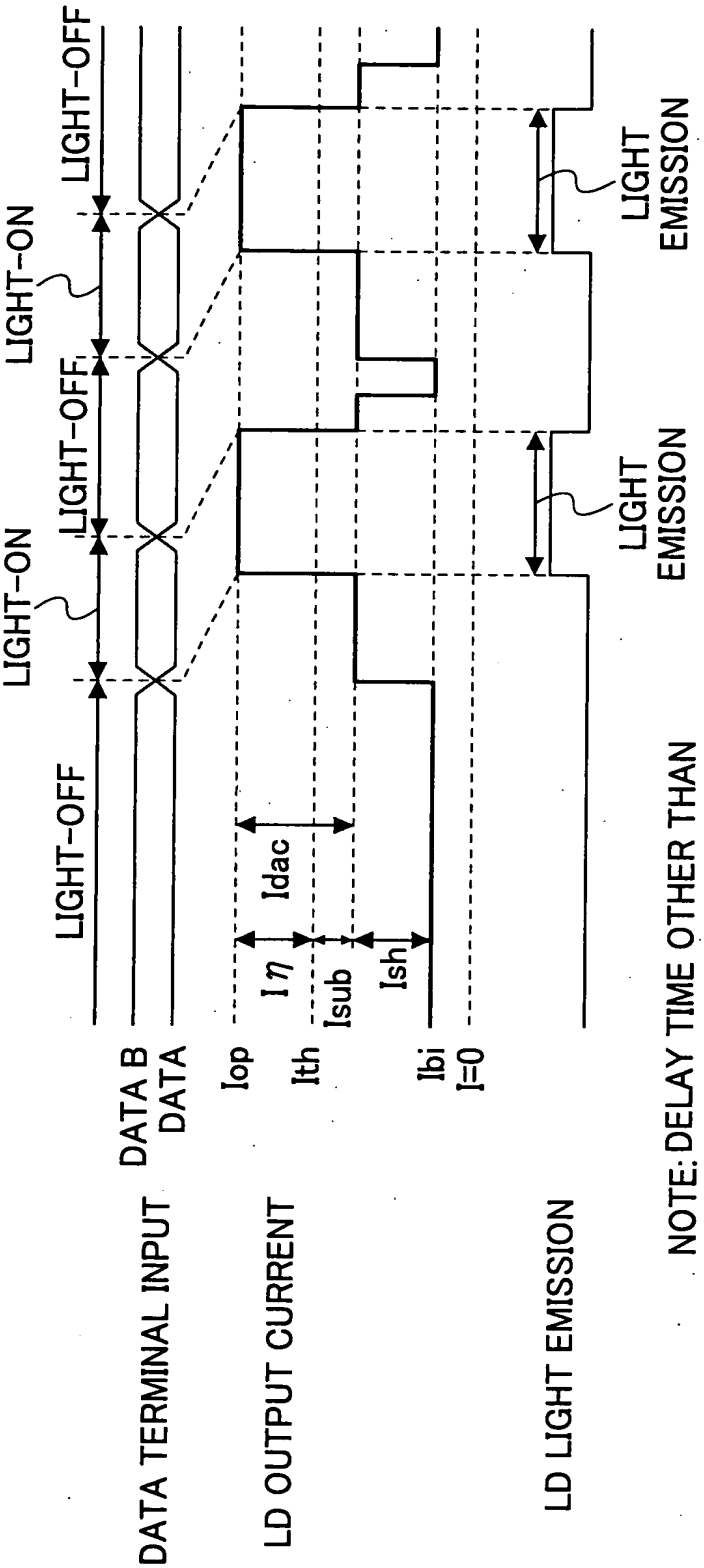
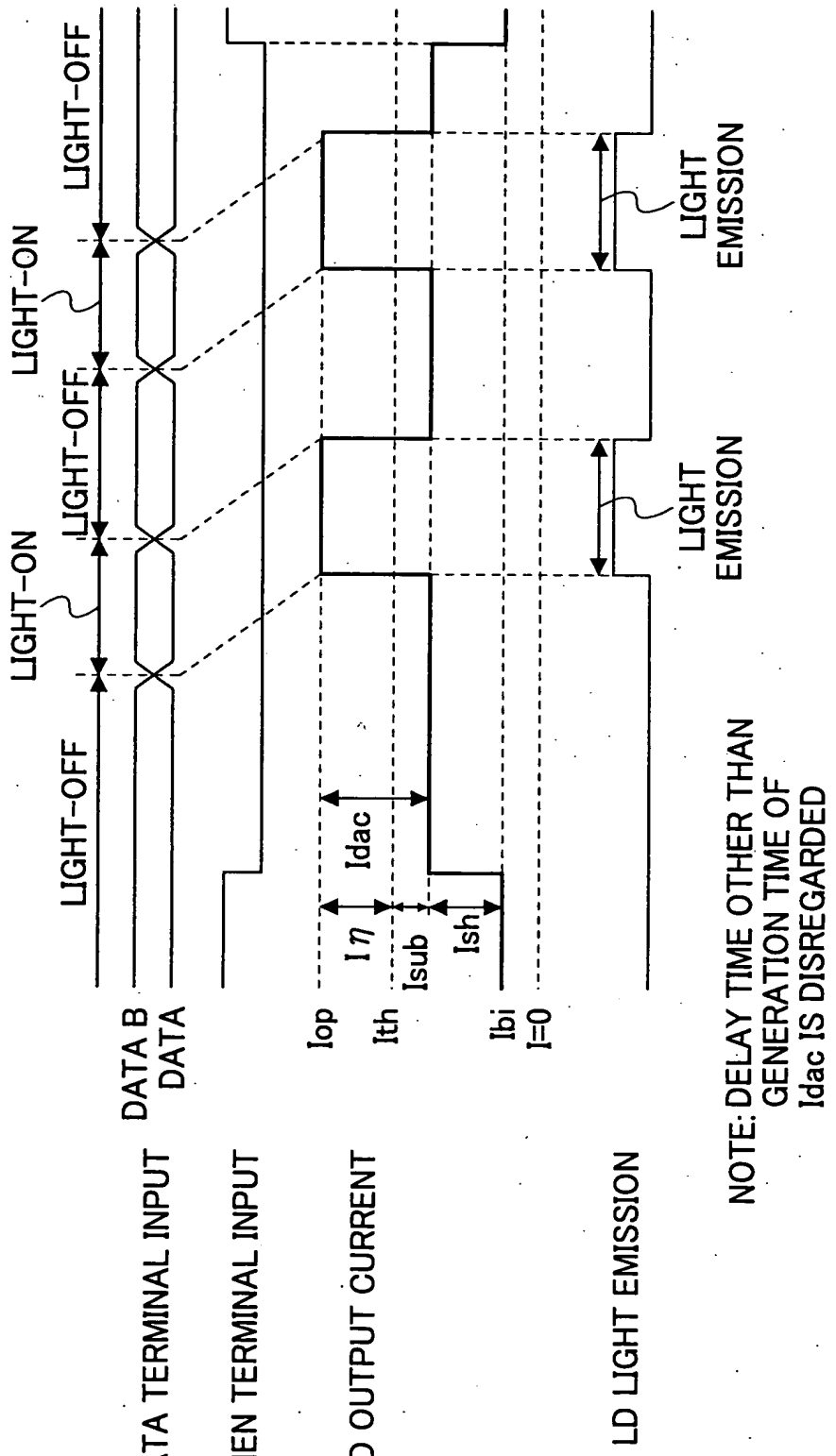

LIGHT-OFF
LIGHT-ON
LIGHT-OFF
LIGHT-ON
LIGHT-OFF
DATA TERMINAL INPUT
DATA B
DATA
Iop
Ith
Ibi
I=0
Idac
Iη
Isub
Ish
LD OUTPUT CURRENT
LIGHT EMISSION
LIGHT EMISSION
LD LIGHT EMISSION
NOTE: DELAY TIME OTHER THAN GENERATION TIME OF Idac IS DISREGARDED

FIG.22


LIGHT-OFF
LIGHT-ON
LIGHT-OFF
LIGHT-ON
LIGHT-OFF
DATA B
DATA
Iop
Ith
Ibi
I=0
Idac
Iη
Isub
Ish
LIGHT EMISSION
LIGHT EMISSION
DATA TERMINAL INPUT
XITHEN TERMINAL INPUT
LD OUTPUT CURRENT
LD LIGHT EMISSION
NOTE: DELAY TIME OTHER THAN GENERATION TIME OF Idac IS DISREGARDED